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Th.o.m.a.s.: An exploratory assessment of Theory of Mind in schizophrenic subjects

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Abstract. A large body of literature agrees that persons with schizophrenia suffer from a Theory of Mind (ToM) deficit. However, most empirical studies have focused on third-person, egocentric ToM, underestimating other facets of this complex cognitive skill. Aim of this research is to examine the ToM of schizophrenic persons considering its various aspects (first vs. second order, first vs. third person, egocentric vs. allocentric, beliefs vs. desires vs. positive emotions vs. negative emotions and how each of these mental state types may be dealt with), to determine whether some components are more impaired than others. We developed a Theory of Mind Assessment Scale (Th.o.m.a.s.) and administered it to 22 persons with a DSM-IV diagnosis of schizophrenia and a matching control group. Th.o.m.a.s. is a semi-structured interview which allows a multi-component measurement of ToM. Both groups were also administered a few existing ToM tasks and the schizophrenic subjects were administered the Positive and Negative Symptoms Scale and the WAIS-R. The schizophrenic persons performed worse than control at all the ToM measurements; however, these deficits appeared to be differently distributed among different components of ToM. Our conclusion is that ToM deficits are not unitary in schizophrenia, which also testifies to the importance of a complete and articulated investigation of ToM.

Keywords: schizophrenia, theory of mind, mindreading, assessment, first person, third person, allocentric perspective, egocentric perspective, clinical interview.

1. Introduction

Theory of Mind (ToM) was initially defined by Premack and Woodruff (1978) as the ability to ascribe mental states to oneself and the others and to use this knowledge to predict and explain the relevant actions and behaviors. Frith (1992, 1994) advanced the hypothesis that underlying the complex symptomatology of schizophrenia may be a deficit of ToM. In Frith's account, the symptoms of schizophrenia — whether positive, like delirium and hallucinations. or negative, like apathy and anhedonia — are consequences of, or reactions to, a breakdown of the ability to handle the mental states of one's own and of the others.

A large body of empirical evidence appears to support Frith's hypothesis: schizophrenic subjects perform worse than normal at several types of ToM tasks (Doody, Götz, Johnstone, Frith & Cunningham Owens, 1998; Corcoran, Mercer & Frith, 1995; Frith & Corcoran, 1996; Mazza, De Risio, Surian, Roncone & Casacchia, 2001; Pickup & Frith, 2001; Mazza, De Risio, Tozzini, Roncone & Casacchia, 2003). Langdon (2003) classified the mentalizing tasks to

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which persons with schizophrenia tend to perform poorly into six types, according to whether they require comprehending false belief and deception stories (Doody, Götz, Johnstone, Frith & Cunningham Owens, 1998; Drury, Robinson & Birchwood, 1998), appreciating visual jokes (Corcoran, Cahill & Frith, 1997), inferring the intentions of characters in comic strips (Sarfati, Hardy-Baylé, Besche & Widlöcher, 1997; Sarfati & Hardy-Baylé, 1999), inferring complex mental states from facial expressions (Kington, Jones, Watt, Hopkin & Williams, 2000; Brüne, 2005a), sequencing picture card stories that require inferring false beliefs (Langdon, Michie, Ward, McConaghy, Catts & Coltheart, 1997; Langdon, Coltheart, Ward & Catts, 2001; Langdon, Coltheart, Ward & Catts 2002; Brüne, 2003), and comprehending non-literal speech acts (Corcoran, Mercer & Frith, 1995; Drury, Robinson & Birchwood, 1998; Mitchley, Barber, Gray, Brooks & Livingstone, 1998; Langdon, Coltheart, Ward & Catts, 2002). To such list can be added the recognition of mental states from close-up photographs of a person's eyes, a task originally created by Baron-Cohen, Wheelwright, Hill, Raste & Plumb (2001) to which schizophrenic subjects perform as poorly (Irani, Platek, Panyavin, Calkins, Kohler, Siegel, Schachter, Gur & Gur, 2006).

The impairment of social cognition in schizophrenia appears to be unrelated to IQ or to the performance at non-social cognitive tasks (Penn, Corrigan, Bentall, Racenstein & Newman, 1997). Therefore, it is better viewed as a specific facet of the symptomatology of the disease than as a consequence of a general cognitive damage (Brüne 2005b).

However, the precise nature of the ToM deficit in schizophrenia is still unclear. While the patients with negative symptoms and those with thought disorder tend to perform poorly at ToM tasks, other results appear equivocal. For example, patients with paranoid delusions do ascribe intentions to others, the problem being that they often ascribe the wrong ones (Blakemore, Sarfati, Bazin & Decety, 2003; Frith, 2004), which lets one think that the problem with their ToM is more a malfunction than an actual breakdown.

Also interestingly, these deficits are not homogeneous: different results may be obtained when different components or sub-skills of ToM are investigated in persons with schizophrenia. Mazza et al. (2001), for example, found the performance of these subjects at first-order ToM tests (Wimmer & Perner, 1983) to be better than that at second-order ones (Perner & Wimmer, 1985). The difference between the two types of task is that success in the former requires to understand a character's belief about a state of the world, while success in the latter requires to ascribe nested mental states, that is to understand a character's belief about the beliefs of another character, which turns out to be more difficult.

The distinction between first- and second-order ToM reasoning is not the only important one. Recent theoretical studies argued that ToM has a complex nature that cannot be reduced to an on-off or an all-or-nothing functioning (Tirassa, Bosco & Colle, 2006a) and pointed to the possibility of decomposing it into different aspects or components. Nichols and Stich (2002) argued that understanding the first and the third persons are different activities that are mediated by different processes and recruit knowledge of different types.

Because most tests of ToM focus on the third person, the functioning of the first person in schizophrenia is substantially less known. However, a study by Gambini, Barbieri and Scarone (2004) supports the idea that the abilities to mentalize in the first and in the third person should be kept distinct. These authors found that, during interviews concerning their delusions, some schizophrenic subjects can gain insight into their own mental states when the perspective is shifted from the first to the third person. A different kind of evidence was provided by an fMRI study conducted by Vogeley, Bussfeld, Newen, Herrmann, Happé, Falkai, Maier, Shah, Fink & Zilles (2001), who found different patterns of brain activation in different lobes as healthy subjects took the first- or the third-person perspective.

Another distinction, orthogonal to that between first- and third-person ToM, is that between egocentrism and allocentrism (Frith & de Vignemont, 2005). In the egocentric perspective, the others are represented in relation to the self, while in the allocentric perspective the others' mental states are represented independently from the self. Again, however, there is no empirical test of this distinction.

To sum up, there is a wide agreement in the literature that ToM is more complex than a monolithic, all-or-nothing function that just turns on and off whenever necessary and functions as whole. Yet, to date there is no single test for its assessment which be able to yield, within a

unitary framework, specific and comparable measures along the first- vs. second-order, the first- vs. third-person, and the egocentrism vs. allocentrism dimensions.

For this reason we developed a new instrument, the Theory of Mind Assessment Scale (Th.o.m.a.s.: Bosco, Colle, Pecorara & Tirassa, 2006), which adopts a unitary methodology to investigate different ToM abilities, thus providing more complete, detailed, and comparable profiles of this elusive function. We administered Th.o.m.a.s. to a group of schizophrenic subjects; we expected their ToM abilities to be damaged, but we also wished to investigate in detail whether specific components or sub-skills were less impaired than another.

In the next section we will describe the ToM Assessment Scale and the hypotheses it allowed to generate; then, we will report the empirical data obtained from its administration to a group of 22 persons suffering from schizophrenia and a matching control group.

2. The Theory of Mind Assessment Scale (Th.o.m.a.s.)

Th.o.m.a.s. is a semi-structured interview aimed at assessing a subject's theory of the mind. It consists of thirty-nine open-ended questions that leave the interviewee free to express and articulate her thought. When they are not provided spontaneously by the interviewee, the interviewer may specifically ask for real-world examples to enrich and contextualize the answer.

Differently from most other instruments for the study of mentalization, where a subject's ToM is appraised based on her performance at predefined tasks, Th.o.m.a.s. is a direct inquiry, where the subject is invited to express her understanding of mental states, both of her own and of the others. Beside what has been discussed in the previous section, another major reason why Th.o.m.a.s. has such structure is the standpoint that we adopt in the ongoing theoretical discussion concerning the very nature and "functioning" of ToM. In brief, the problem is whether ToM consists of an explicit, formal, substantially linguistic form of reasoning or also (or only) of other, less theorematic and less local activities (Gallagher, 2001; Zahavi, 2005; Gallagher & Hutto, 2008).

There is no space to discuss the issue here, nor is it the focus of this paper (but see Tirassa, Bosco & Colle, 2006b; Tirassa & Bosco, 2008). We have little doubt that, as humans, we can engage in highly complex ToM reasoning when we need or want to, as it happens when a general attempts to foresee and understand what his opponent's strategies will be on the battlefield; yet, there can be as little doubt that we do not explicitly represent and reason about the mental states of anybody who happens to smile and say hello to us or to be drinking a double whiskey in the bar where we are eating a sandwich. In the latter cases, we are not making any theory about the other's mental states (or even about those of our own), and we may hardly ever notice that there is a social activity going on in which we are immersed. Yet, our mental activities are not devoid of a social, mentalizing flavor — our observations of or actions toward these individuals are fully informed by our comprehension that the former is treating us gently, and that the latter is a thirsty customer of the bar. This is why we are ready to smile and shake hands with the one, or to understand why the other is beginning to mutter about having lost a job and a spouse.

Th.o.m.a.s. builds on the idea that the human mentalizing abilities are basically a way to look at the world, a background which informs our whole social life and against which more explicit, theory-driven reasoning episodes become possible and meaningful. We felt that an interview would be more appropriate to let such worldview emerge, without focusing too much on the more formal, theorematic activities that may or may not be employed moment by moment by an individual, particularly one with a mental problem.

The interview is originally in Italian. The questions of which it is composed (see Appendix 1) are organized along four scales, each focusing on one of the knowledge domains in which a person's ToM may manifest itself.

- *Scale A, I–Me.* It investigates the interviewee's knowledge of her own mental states. The viewpoint of the questions is centered on the interviewee (*I*) reflecting on her own mental states

(*Me*), (e.g., "Do you ever experience emotions that make you feel good?"). This scale investigates first-person ToM in an egocentric perspective.

- *Scale B, Other–Self*. It investigates the knowledge that, according to the interviewee, the other persons have of their own mental states, independently of the subject's perspective. The viewpoint of the questions is centered on the other persons (*Other*) reflecting on their own mental states (*Self*), (e.g., "Do the others try to fulfill their wishes?"). This scale investigates third-person ToM in an allocentric perspective.
- *Scale C, I–Other*. It investigates the interviewee's knowledge of the mental states of other persons. The viewpoint of the questions is centered on the interviewee (*I*) reflecting on the others' mental states (*Other*), (e.g., "Do you notice it when the others feel good?"). This scale is similar to scale B in that they both investigate third-person ToM; however, while the perspective there is centered on the other, here it is centered on the interviewee. In other words, here the subject is asked to take an egocentric perspective.
- *Scale D, Other–Me*. It investigates the knowledge that, from the interviewee's point of view, the others have of her mental states. The viewpoint of the questions is centered on the other persons (*Other*) reflecting on the mental states of the interviewee (*Me*), (e.g., "Do the others notice it when you feel good?"). This scale can be compared with a 2nd-order ToM task, in that the abstract form of the questions is: "What do you think that the others think that you think?"

Each scale is divided into three subscales that respectively explore the dimensions of Awareness, Relation and Realization of mental states:

- *Awareness*. It investigates the interviewee's ability to perceive and differentiate beliefs, desires and emotions in herself and in the others. Recognizing different types of mental states is a necessary precondition of understanding their links and causal relations with one another and with the external world.
- *Relation*. It investigates the interviewee's ability to recognize causal relations between different mental states and between them and the resulting behaviors. For example: "When you feel bad, do you feel you understand why?". Being capable to connect and to integrate different mental states and to understand their reciprocal relations and bi-directional connections with perceptions and actions is necessary to draw up an explanatory theory of the mind and of the social world.
- *Realization*. It investigates the interviewee's ability to adopt effective strategies to achieve a desired state. For example: "Do you succeed in getting what you want? How?". To act adaptively requires not only to have a theory of the causal relations between mental states and between the mental states and the world, but also to know how to use this knowledge to appropriately and successfully affect the mental states and the behavior of one's own and of the others.

Based on current theorizing on the most important types of mental states that an agent's cognitive architecture has to comprise (Tirassa, 1999; Tirassa & Bosco, 2008), the questions focus on the interviewee's perspectives on epistemic states (knowledge, beliefs and so on), volitional states (desires, intentions and so on) and positive and negative emotions.

In a graphic representation of the structure of the interview (see Appendix 2), the four scales and their subscales are the columns of a table whose rows represent the types of mental states investigated. Thus, each cell of the table represents a specific intersection of two of the dimensions that the interview considers. Each question in its turn refers to a specific cell of the table, that is it encourages the interviewee to express her understanding of the relevant aspect of the activities of the mind.

For example, question [1]: "Do you happen to experience emotions that make you feel good?" explores the ability to identify one's own positive emotions (dimensions investigated: Awareness and Positive emotions). Question [7]: "Do you happen to have wishes, and know

what you want?" encourages the interviewee to express her awareness of her own desires (dimensions investigated: Awareness and Desires). Analogous considerations can be made for each question. This structure is replicated for all four scales. Wherever appropriate, the interviewee is asked to provide one or more episodic examples.

In line with the current literature, we expected the schizophrenic subjects to show an impaired ToM when compared with control. However, we expected some aspects of their ToM to be better preserved than others. In particular, their score at scale A (I–Me), which assesses first-person ToM, may significantly differ from that at scale B (Other–Self), which evaluates third-person ToM.

We also investigated possible differences in the subjects' performance at scales B (Other–Self) and C (I–Other): both investigate third-person ToM, but the former takes an allocentric perspective and the latter an egocentric one.

Finally, we investigated possible differences between scales A, B, and C, which investigate first-order ToM, and scale D, which investigates 2nd-order ToM.

3. Method

3.1 Participants

Twenty-two persons with a diagnosis of schizophrenia according to the DSM-IV (APA, 1994) helped us to collect the present data. All participants were outpatients of the San Gerardo Hospital of Monza (Psychosocial Center of Besana Brianza). All participants were native speakers of Italian. None was acutely or florid psychotic: all were tested in their chronic phase. The DSM-IV subtypes were so distributed: paranoid (11 subjects), undifferentiated (4 subjects), disorganized (3 subjects), residual (4 subjects). The subjects were receiving medication: 9 received typical medicine (haloperidol and methotrimeprazine, a.k.a. levomepromazine), 11 atypical (clozapine, quetiapine, risperidone and olanzapine), 2 both typical and atypical. The mean of illness onset was 25.86 years (standard deviation — s.d. = 6.18) and the mean duration of illness was 13.73 (s.d. = 6.47).

Inclusion criterion for schizophrenic subjects was $IQ > 70$, evaluated with the WAIS-R¹; their mean IQ was 90 ± 15 .

The symptomatology of the schizophrenic subjects at the time of testing was investigated with the Positive and Negative Syndrome Scale (PANSS: Kay et al., 1987). It consists of thirty items subdivided into 3 scales: one for positive symptoms (7 items), one for negative symptoms (7 items) and a general psychopathology scale (16 items); each item is assessed on a 7-points scale ranging from "absent" (1) to "extremely serious" (7). The subjects' mean scores were: Negative symptoms 25.86 (s.d. = 6.18), Positive symptoms 7.5 (s.d. = 4.65), General symptoms 45.00 (s.d. = 12.47).

A control group of healthy persons was also included in the study. The two groups were matched for sex (schizophrenic subjects: 12 females, 10 males; controls: 12 females, 10 males), age (schizophrenic subjects: mean = 39.59 ± 9.51 ; controls: mean 38.5 ± 9.8), and years of formal education (schizophrenic subjects: mean = 10.4 ± 3.35 ; controls: mean 10.18 ± 3.06).

Exclusion criteria for both schizophrenic subjects and controls included an anamnesis of neurological or neuropsychological disease, leucotomy, head injury, and substance or alcohol abuse (both defined as per DSM-IV).

3.2 Materials and procedures

In addition to Th.o.m.a.s., the following ToM tests were administered in vivo to both the schizophrenic subjects and the controls.

Sally and Ann (Baron-Cohen, Leslie & Frith, 1985). The experimenter, holding a doll named Sally and one named Ann, says: "Sally places her ball in the basket and leaves the scene. Ann

¹ We administered the full version of WAIS-R, adapted and standardized for Italian persons.

moves the ball from the basket to the box". While speaking, the experimenter acts out the corresponding gestures and then asks the subject: "When Sally comes back, where will she think her ball is?"

Smarties modified (Cigarettes). This is a modified version (Pickup & Frith, 2001) of the original Smarties task (Perner et al., 1987). The experimenter shows the subject a cigarette pack and asks: "What is inside this?". Of course the subject answers: "Cigarettes". The experimenter then opens the pack, shows that it contains pencils instead, closes it again and asks: "When the nurse enters, what will she think is inside?"

Strange Stories (Happé, Brownell & Winner, 1999). We presented a selection of six Strange Stories, excluding those that require the comprehension of communicative acts like metaphors and irony. An example is the following story: "A burglar who has just robbed a shop is making his getaway. As he is running home, a policeman on his beat sees him drop his glove. He doesn't know the man is a burglar, he just wants to tell him he dropped his glove. But when the policeman shouts out to the burglar, 'Hey, you! Stop', the burglar turns round, sees the policeman and gives himself up. He puts his hands up and admits that he did the break-in at the local shop." The subject is asked: "Why did the burglar do that?" A correct interpretation of the situation requires to assess the burglar's mental state and to realize that he misunderstood the policeman's intention, which was to give back the glove.

With the authorization of the interviewees, all Th.o.m.a.s. interviews (subjects and controls) were tape-recorded and then transcribed.² The transcriptions were rated by two independent judges, who had not participated to the interviewing phase and were blind to whether each person whose answers they were coding belonged to the experimental or the control group.

Each judge was asked to assign each answer a score from 0 to 4, according to the given rating criteria (see Appendix 3), and to insert it in the relevant cell of the correction grid (see Appendix 2).

The two judges reached a significant level of inter-reliability on their first judgments of the schizophrenic subjects' and the control subjects' answers, considered separately, both considering the total Th.o.m.a.s. scores (Correlation Coefficient: correlation ranging from .83 to .86, $p < .001$) and each subscale (Correlation Coefficient: correlation ranging from .81 to .91, $p < .001$). For the final score assignment they discussed each item upon which they disagreed until a full agreement was reached.

The two judges also scored the other ToM tests, following the relevant criteria available in the literature, assigning 0 to each incorrect answer and 1 to each correct one.

4. Results

4.1 Between-groups differences

Figure 1 shows the mean scores for the schizophrenic subjects and the controls to each Th.o.m.a.s. scale. We performed an ANOVA with two levels on between factors (*subject group*: subjects vs. controls) and four levels on within factors (*scale type*: A, I–Me; B, Other–Self; C, Me–Other; D, Other–Me). As expected, there was a significant main effect of subject group ($F_{1,38} = 5.09$, $p < .001$) and a main effect of scale type ($F_{3,114} = 8.55$, $p < .001$). Figure 1 reveals that the subjects performed worse than the controls at all scale types. The interaction between subjects and scale type was not significant.

Figure 2 shows the mean scores for the schizophrenic subjects and the controls to each Th.o.m.a.s. subscale. We performed an ANOVA with two levels on between factors (*subject group*: subjects vs. controls) and three levels on within subjects factors (*subscale type*: Awareness, Relation, Realization). Again as expected, there was a significant main effect of

² Technical problems occurred in recording part of two subjects' interview. These data are treated as missing values.

subject group ($F_{1,38} = 34.90$, $p < .001$) and a main effect of subscale type ($F_{2,76} = 5.71$, $p = .0049$). Figure 2 reveals that the subjects performed worse than the controls at all subscale types. The interaction between subject and subscale type was significant too ($F_{2,76} = 5.72$, $p = .015$).

Figure 3 shows the mean scores for the schizophrenic subjects and the controls to each Th.o.m.a.s. dimension. We performed an ANOVA with two levels on between factors (*subject group*: subjects vs. controls) and four levels on within subjects factors (*dimension type*: Desires, Beliefs, Positive emotions, Negative emotions). Again as expected, there was a significant main effect of subject group ($F_{1,38} = 36.17$, $p < .001$) and a main effect of dimension type ($F_{3,114} = 5.37$, $p = .0017$). Figure 3 reveals that the subjects performed worse than controls at all dimension types. The interaction between subjects and dimension type was not significant.

Finally, the overall performance at the conventional ToM tasks was 69% of correct answers for the subjects and 95% for the controls; as expected, this difference was significant (T test: $t = 3.75$, $p = .0012$).

4.2 Schizophrenic subjects' performance at Th.o.m.a.s.

Focusing on the schizophrenics' performance at Th.o.m.a.s., we conducted a within subjects ANOVA with four levels on within subjects factors (*scale type*: A, I–Me; B, Other–Self; C, Me–Other; D, Other–Me). We found significant differences between the schizophrenics' mean scores at the four individual scales ($F_{3,57} = 5.95$, $p = .001$, see Figure 1). In particular, as expected, post hoc pairwise comparison (Bonferroni corrected: p ranging from $p = .027$ to $p = .028$) revealed that the subjects scored higher at scale A (I–Me), which assesses first-person ToM, than at all the other three scales: B (Other–Self) and C (Me–Other), both of which assess third-person ToM, and D (Other–Me), which assesses ToM with a second-level inference. No significant differences existed between the latter three scales.

We also conducted a within subjects ANOVA with three levels on within subjects factors (*subscale type*: Awareness, Relation, Realization) that revealed a significant difference between the schizophrenics' total mean performance at the three subscales ($F_{2,38} = 6.64$, $p = .003$) (see Figure 2). In particular, post hoc pairwise comparisons revealed that the subjects scored higher at the Awareness subscale than at the Relation subscale (Bonferroni corrected: $p < .001$), while there was no significant difference between the others.

For explorative purposes, we investigated whether differences existed between the schizophrenic subjects' total mean performance at the four dimensions (Beliefs, Desires, Positive emotions, Negative emotions) but found none (within subjects ANOVA: $F_{3,57} = 2.72$, $p = .053$) (see figure 3).

4.3 Correlations within the schizophrenics' group

We investigated the correlations between the schizophrenics subjects' scores at Th.o.m.a.s. and at the conventional ToM tests, finding that there existed both with the Th.o.m.a.s. total score (Correlation = .54, $p = .013$), and with scales A, B, and C (Correlation: ranging from .045 to .065, p ranging from .0013 to .033). No correlation was instead found with scale D (Correlation = .41, $p = .073$) (see Table 1).

We also found a correlation between the schizophrenic subjects' IQ and their mean scores both at Th.o.m.a.s. total (Correlation = .57, $p = .0072$) and at scales B, C and D (Correlation ranging from .48 to .70, p ranging from .02 to .0004), while none was found with scale A (Correlation = .27, $p = .23$).

We ruled out a correlation between the schizophrenic subjects' years of education and their mean scores at either Th.o.m.a.s. total and at scales A, B, and C (Correlation ranging from .22 to .40, p ranging from .07 to .32), with the exception of scale D (Correlation .53, $p = .014$).

Finally, we correlated the PANSS score and the Th.o.m.a.s. score: significant correlations are reported in Table 1.

5. Conclusions

The Theory of Mind Assessment Scale (Th.o.m.a.s.) is meant to provide a more articulated and thorough investigation of ToM than those available in the literature. It provides specific and comparable measures of ToM within a unitary framework, taking into account the distinctions between first and second order, between the first and the third person, between the egocentric and the allocentric perspective, and between different types of mental states and how each of them may be dealt with. In addition, it provides a direct inquiry of how the interviewee views her capability to understand and deal with her own mental states and those of the others.

In line with Frith's (1992) hypotheses, we found an impaired ToM to be associated with schizophrenia. The global Th.o.m.a.s. score of the schizophrenic subjects we examined was worse than control, as was their performance at each of the four scales (A, B, C and D), at each of the three subscales (Awareness, Relation, and Realization), and at each of the four types of mental state assessed (Beliefs, Desires, Positive emotions, and Negative emotions). Globally, our results are aligned with the literature, showing a ToM deficit in schizophrenia (for overviews see Casacchia, Mazza & Roncone, 2004, and Harrington, Siegert & McClure, 2005).

However, in line with our hypothesis, we found that schizophrenic subjects show a variegated performance to questions that, albeit conceived and formulated in similar ways and within a unitary framework, involve different aspects of ToM: some ToM abilities, however impaired with respect to controls, turned out to be better preserved than others: on the average, schizophrenic subjects scored higher at scale A, which assesses first-person ToM, than at scales B and C, which assess third-person ToM. They scored equally at the latter two, which means that their performance did not differ whether the questions concerning third-person ToM took an allocentric (scale B) or an egocentric (scale C) perspective. This supports the ideas that first-person ToM is better preserved in schizophrenia than third-person ToM and that there are no significant differences in this respect between egocentric and allocentric perspective.

Whether humans are better at reasoning in the first or in the third person is a current matter of hot debate. Our results support Goldman's hypothesis (1993) that they can better reason about their own mental states than about those of the others.

Other researchers, however, argue in favor of the opposite view (e.g., Gopnik, 1993). On interviewing schizophrenics about their delusions, Gambini et al. (2004) found that they performed better at the third person than at the first. The relevant questions were "Do you really think that what you just told me is real? Do you have any doubt about it?" or "If you were me, would you consider reasonable what you just told me? If someone else told you what you just told me, would you believe them?" However, the better performance at the latter questions than at the former could be explained by the subjects' experience that doctors, family members and, in general, the other persons do not consider their delusions plausible or reasonable, rather than by a truly better capability of reasoning about the others' mind.

Further research thus appears to be needed regarding first- vs. third-person ToM.

Finally, the schizophrenic subjects performed at scale D worse than at scale A: this is not surprising, because the latter requires a first-order inference while the former requires a second-order one.

As regards the three Th.o.m.a.s. subscales (Awareness, Relation, and Realization), the schizophrenic subjects' mean performance at the Awareness subscale is significantly higher than that at the Relation subscale. This suggests that, at least limitedly to our experimental paradigm, their ability to be aware of and reflect upon mental states is impaired — as shown by the comparison with the control group —, but less than their ability to understand the causal links that mental states have with each other and with behavior. Reasonably, relation and realization appear to be more complex than the mere recognition of inner states. No significant difference emerged from the other comparisons between the subscales or from the comparison between the four mental states types explored (Beliefs, Desires, Positive emotions, and Negative emotions).

A significant correlation existed between standard ToM tests (Sally and Ann, Cigarettes, and Strange Stories) and both the overall Th.o.m.a.s. score and scales A, B and C. This correlation does not exist with scale D (Other–Me): this is not surprising because D assesses second-order ToM, which is not specifically investigated by any of the conventional ToM test we used.

The schizophrenic subjects' IQ had a significant correlation both with the total Th.o.m.a.s. scores and with scales B (Other–Self), C (I–Other), and D (Other–Me), but not A (I–Me), probably because the latter is the easiest.

The relation between ToM and IQ in schizophrenia has been investigated in the literature, but not with univocal results. Doody et al. (1998) found that the schizophrenics' deficit in second-order ToM did not correlate with their IQ, while Pickup and Frith (2001) found a ToM impairment only in a second-order task and it was associated with low IQ. Brüne (2003) found a correlation between the verbal IQ of schizophrenic subjects and their performance at ToM tasks; the correlation still existed when the IQ of the subjects and of the controls was matched. Generalizing from the literature, ToM performance appears to be affected, but not completely explained, by IQ (Mitchley, Barber, Gray, Brooks & Livingstone, 1998; Garety & Freeman, 1999; Greig, Bryson & Bell, 2004).

In this regard, we also found that the education level of the schizophrenic subjects did not correlate with their global Th.o.m.a.s. score or with the scores at the individual scales, with the exception of scale D (Other–Me). Our instrument thus appears to reliably measure ToM capabilities and not education or intelligence. The correlation with scale D is probably due to the greater difficulty of the latter, which requires a second-order perspective and might therefore require intellectual skills beside ToM.

We then investigated the correlation between the subjects' scores at PANSS and at Th.o.m.a.s. The PANSS general psychopathology score correlated with the mean Th.o.m.a.s. total score and with each individual scale, with the exception of scale D. The PANSS scale of negative symptoms correlated negatively with both the total Th.o.m.a.s. score and each individual scale, while the scale of positive symptoms correlated significantly with the Th.o.m.a.s. total score and with scales A and C, but not B and D.

These results are in line with those of Lysaker, Carcione, Dimaggio, Johannesen, Nicolò, Procacci & Semerari (2005), who applied the Metacognition Assessment Scale — originally developed for the evaluation of mentalization during psychotherapy (Semerari, Carcione, Dimaggio, Falcone, Nicolò, Procacci & Alleva, 2003) — to the narratives of schizophrenic persons, finding that depressed mood, a general symptom, correlated with their ability to understand their own mind (first person). Emotional withdrawal, a negative symptom, correlated with their ability to understand both their own mind and that of the others, while hallucinations, a positive symptom, correlated with their ability to understand their own mind but not with their ability to understand that of the others. Our results concerning the correlation with the negative symptoms are also in line with Langdon, Michie, Ward, McConaghy, Catts & Coltheart (1997) and Langdon, Coltheart, Ward & Catts (2001), who argued that the patients with prevailing negative symptoms are those whose ToM is impaired most severely.

On the whole, these results support the idea that positive and negative symptoms relate differently to different facets of ToM impairment.

A limitation of our study lies in the fact that we could not distinguish different sub-types of schizophrenic subjects so to explore whether their performances at Th.o.m.a.s. differ. Yet, according to the current literature different symptoms may relate to different ToM performances. In the same vein, it might be interesting to define the specific performance of each sub-type of schizophrenia at the various Th.o.m.a.s. subscales and components.

Furthermore, studies in literature showed that schizophrenia is associated with deficits in communicative (Hoffman & Grove, 1985; Frith & Allen, 1988), mnemonic and executive functioning abilities (Stirling, 1997; Bryson, Whelahan & Bell, 2001; Silver, Feldman, Bilker & Gur, 2003; Oram, Geffen, Geffen, Kavanagh & McGrath, 2005). Further work could benefit from a more fine-grained assessment of these abilities, so to correlate a poor ToM performance with their possible impairment (see for example Lysaker et al., 2005).

Overall, and given the complexity of the disorder investigated, we view this research as initial. Further, more in-depth examination is needed. However initial, though, our results show that ToM impairments may and do come in different types and degrees according to the domain considered: first vs. third person, first vs. second order, egocentric vs. allocentric, Awareness vs. Relation and Realization, etc. This appears to encourage this research direction to promote a more thorough understanding of this crucial and complex faculty and of its impairments.

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References

- Andreasen, N. C., Grove, W. M., & Hoffman, R. E. (1985). Language abnormalities in schizophrenia. In M. V. Seeman & N. M. Menuck (Eds.), *New perspectives in schizophrenia*, pp. 97-120. New York: Macmillan Press.
- APA (American Psychiatric Association) (1994). *Diagnostic and statistical manual of mental disorders*. Washington, DC (4th ed.).
- Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a theory of mind? *Cognition*, 21, 37-46.
- Baron-Cohen, S., Wheelwright, S., Hill, S., Raste, Y., & Plumb, I. (2001). The "Reading the Mind in the Eyes" test revised version: A study with normal adults, and adults with Asperger syndrome or high functioning autism. *Journal of Child Psychological Psychiatry*, 42, 241-251.
- Blakemore, S. J., Sarfati, Y., Bazin, N., & Decety, J. (2003). The detection of intentional contingencies in simple animations in patients with delusions of persecution. *Psychological Medicine*, 33, 1433-1441.
- Bosco, F. M., Colle, L., Pecorara, R. S., & Tirassa, M. (2006). Th.o.m.a.s., Theory of Mind Assessment Scale: Uno strumento per la valutazione clinica della teoria della mente. *Sistemi Intelligenti*, 2, 215-242.
- Brüne, M. (2003). Theory of Mind and the role of IQ in chronic disorganized schizophrenia. *Schizophrenia Research*, 60, 57-64.
- Brüne, M. (2005a). Emotion recognition, "theory of mind", and social behavior in schizophrenia. *Psychiatry Research*, 133, 135-147.
- Brüne, M. (2005b). "Theory of mind" in schizophrenia: A review of the literature. *Schizophrenic Bulletin*, 31, 21-42.
- Bryson, G., Whelahan, H. A., & Bell, M. (2001). Memory and executive function impairments in deficit syndrome schizophrenia. *Psychiatry Research*, 102, 29-37.
- Casacchia, M., Mazza, M., & Roncone, R. (2004). Theory of mind, social development and psychosis. *Current Psychiatry Reports*, 6, 183-189.
- Corcoran, R., Cahill, C., & Frith, C. D. (1997). The appreciation of visual jokes in people with schizophrenia. A study of "mentalizing" ability. *Schizophrenia Research*, 24, 319-327.
- Corcoran, R., Mercer, G., & Frith, C. D. (1995). Schizophrenia, symptomatology and social inference: Investigating theory of mind in people with schizophrenia. *Schizophrenia Research*, 17, 5-13.
- Doody, G. A., Götz, M., Johnstone, E. C., Frith, C. D., & Cunningham Owens, D. G. (1998). Theory of Mind and psychoses. *Psychological Medicine*, 28, 397-405.
- Drury, V. M., Robinson, E. J., & Birchwood, M. (1998). Theory of mind skills during acute episode of psychosis and following recovery. *Psychological Medicine*, 28, 1101-1112.
- Frith, C. D. (1992). *The cognitive neuropsychology of schizophrenia*. Hove, UK, and Hillsdale, NJ: Erlbaum.
- Frith, C. D. (1994). Theory of mind in schizophrenia. In A. S. David & J. C. Cutting (Eds.), *Neuropsychology of schizophrenia*, pp. 147-162. Hillsdale, NJ: Erlbaum.
- Frith, C. D. (2004). Schizophrenia and theory of mind. *Psychological Medicine*, 34, 385-389.
- Frith, C. D., & Allen, H. A. (1988). Language disorders in schizophrenia and their implications for neuropsychology. In P. Bebbington & P. McGuffin (Eds.), *Schizophrenia: The major issues*, pp. 172-186. Oxford, UK: Heinemann.
- Frith, C. D., & Corcoran, R. (1996). Exploring 'theory of mind' in people with schizophrenia. *Psychological Medicine*, 26, 521-530.
- Frith, U., & de Vignemont, F. (2005). Egocentrism, allocentrism, and Asperger syndrome. *Consciousness and Cognition*, 14, 719-738.
- Gallagher, S. (2001). The practice of mind: Theory, simulation, or interaction? *Journal of Consciousness Studies*, 5-7, 83-108.
- Gallagher, S., & Hutto, D. (2008). Understanding others through primary interaction and narrative. In T. Racine, C. Sinha, J. Zlatev & E. Itkonen (Eds.), *The shared mind: Perspectives on intersubjectivity*. Amsterdam: Benjamins.
- Gambini, O., Barbieri, V., & Scarone, S. (2004). Theory of Mind in schizophrenia: First person vs. third person perspective. *Consciousness and Cognition*, 13, 39-46.
- Garety, P. A., & Freeman, D. (1999). Cognitive approaches to delusions: A critical review of theories and evidence. *British Journal of Clinical Psychology*, 38, 113-154.
- Goldman, A. (1993). The psychology of folk psychology. *Behavioral and Brain Sciences*, 16, 15-28.
- Gopnik, A. (1993). How we know our own minds: The illusion of first-person knowledge of intentionality. *Behavioral and Brain Sciences*, 16, 1-14.
- Greig, T. C., Bryson, G. J., & Bell, M. D. (2004). Theory of mind performance in schizophrenia: Diagnostic, symptom, and neuropsychological correlates. *Journal of Nervous and Mental Disease*, 192, 12-16.
- Happé, F., Brownell, H., & Winner, E. (1999). Acquired theory of mind impairment following stroke. *Cognition*, 70, 211-240.
- Harrington, L., Siegert, R. J., & McClure, J. (2005). Theory of mind in schizophrenia: A critical review. *Cognitive Neuropsychiatry*, 10, 249-286.

- Irani, F., Platek, S. M., Panyavin, I. S., Calkins, M. E., Kohler, C., Siegel, S. J., Schachter, M., Gur, R. E., & Gur, R. C. (2006). Self-face recognition and theory of mind in patients with schizophrenia and first-degree relatives. *Schizophrenia Research*, 88, 151-160.
- Kay, S. R., Fiszbein, A., & Opler, L. A. (1987). The positive and negative symptoms scale (PANSS) for schizophrenia. *Schizophrenic Bulletin*, 13, 261-276.
- Kington, J. M., Jones, L. A., Watt, A. A., Hopkin, E. J., & Williams, J. (2000). Impaired eye expression recognition in schizophrenia. *Journal of Psychiatric Research*, 34, 341-347.
- Langdon, R. (2003). Theory of mind and social dysfunction: Psychotic solipsism versus autistic asociality. In B. Repacholi & V. Slaughter (Eds.), *Individual differences in theory of mind: Implications for typical and atypical development*, pp. 241-270. Hove, UK: Psychology Press.
- Langdon, R., Coltheart, M., Ward, P. B., & Catts, S. V. (2001). Mentalising, executive planning and disengagement in schizophrenia. *Cognitive Neuropsychiatry*, 2, 81-108.
- Langdon, R., Coltheart, M., Ward, P. B., & Catts, S. V. (2002). Disturbed communication in schizophrenia: The role of poor pragmatics and poor mind-reading. *Psychological Medicine*, 32, 1273-1284.
- Langdon, R., Michie, P. T., Ward, P. B., McConaghy, N., Catts, S. V., & Coltheart, M. (1997). Defective self and/or other mentalizing in schizophrenia: A cognitive neuropsychological approach. *Cognitive Neuropsychiatry*, 2, 167-193.
- Lysaker, P. H., Carcione, A., Dimaggio, G., Johannesen, J. K., Nicolò, G., Procacci, M., & Semerari, A. (2005). Metacognition amidst narratives of self and illness in schizophrenia: Associations with neurocognition, symptoms, insight and quality of life. *Acta Psychiatrica Scandinavica*, 112, 64-71.
- Mazza, M., De Risio, A., Surian, L., Roncone, R., & Casacchia, M. (2001). Selective impairments of theory of mind in people with schizophrenia. *Schizophrenia Research*, 47, 299-308.
- Mazza, M., De Risio, A., Tozzini, C., Roncone, R., & Casacchia, M. (2003). Machiavellianism and theory of mind in people affected by schizophrenia. *Brain and Cognition*, 51, 262-269.
- Mitchley, N. J., Barber, J., Gray, J. M., Brooks, D. N., & Livingstone, M. G. (1998). Comprehension of irony in schizophrenia. *Cognitive Neuropsychiatry*, 3, 127-138.
- Nichols, S., & Stich, S. (2002). How to read your own mind: A cognitive theory of self-consciousness. In Q. Smith & A. Jokic (Eds.), *Consciousness: New philosophical essays*. Oxford: Oxford University Press.
- Oram, J., Geffen, G. M., Geffen, L. B., Kavanagh, D. J., & McGrath, J. J. (2005). Executive control of working memory in schizophrenia. *Psychiatry Research*, 135, 81-90.
- Penn, D. L., Corrigan, P. W., Racenstein, R. P., Racenstein, J. M., & Newman L. (1997). Social cognition in schizophrenia. *Psychological Bulletin*, 121, 114-132.
- Perner, J., Leekam S. R., & Wimmer H. (1987). Three-year-olds' difficulty with false belief: The case for a conceptual deficit. *British Journal of Developmental Psychology*, 5, 125 - 137.
- Perner, J., & Wimmer, H. (1985). John thinks that Mary thinks that... Attribution of second order beliefs by 5-to 10-year-old children. *Experimental Child Psychology*, 39, 437-471.
- Pickup, G. J., & Frith, C. D. (2001). Theory of mind impairments in schizophrenia: Symptomatology, severity and specificity. *Psychological Medicine*, 31, 207-220.
- Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences*, 1, 512-526.
- Sarfati, Y., & Hardy-Baylé, M. C. (1999). How do people with schizophrenia explain the behavior of others? A study of mind and its relationship to thought and speech disorganization in schizophrenia. *Psychological Medicine*, 29, 613-620.
- Sarfati, Y., Hardy-Baylé, M. C., Besche, C., & Widlöcher, D. (1997). Attribution of intentions to others in people with schizophrenia. *Schizophrenia Research*, 25, 199-209.
- Semerari, A., Carcione, A., Dimaggio, G., Falcone, M., Nicolò, G., Procacci, M., & Alleva, G. (2003). How to evaluate metacognitive functioning in psychotherapy? The Metacognition Assessment Scale and its applications. *Clinical Psychology and Psychotherapy*, 10, 238-261.
- Silver, H., Feldman, P., Bilker, W., & Gur, R. C. (2003). Working memory deficit as a core neuropsychological dysfunction in schizophrenia. *American Journal of Psychiatry*, 160, 1809-1816.
- Stirling, J. D., Hellewell, J. S., & Hewitt, J. (1997) Verbal memory impairment in schizophrenia: No sparing of short term recall. *Schizophrenia Research*, 25, 85-95.
- Tirassa, M. (1999). Communicative competence and the architecture of the mind/brain. *Brain and Language*, 68, 419-441.
- Tirassa, M., & Bosco, F. M. (2008). On the nature and role of intersubjectivity in communication. In F. Morganti, A. Carassa & G. Riva (Eds.), *Enacting intersubjectivity: A cognitive and social perspective to the study of interactions*. Amsterdam: IOS Press.
- Tirassa, M., Bosco, F. M., & Colle, L. (2006a). Rethinking the ontogeny of mindreading. *Consciousness and Cognition*, 15, 197-217.
- Tirassa, M., Bosco, F. M., & Colle, L. (2006b). Sharedness and privateness in human early social life. *Cognitive Systems Research*, 7, 128-139.
- Vogeley, K., Bussfeld, P., Newen, A., Herrmann, S., Happé, F., Falkai, P., Maier, W., Shah, N. J., Fink, G. R., & Zilles, K. (2001). Mind reading: Neural mechanism of theory of mind and self-perspective. *Neuroimage*, 14, 170-181.
- Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, 13, 103-128.
- Zahavi, D. (2005). *Subjectivity and selfhood: Investigating the first-person perspective*. Cambridge, MA: MIT Press.

Appendix 1. The interview

This appendix contains the complete interview, divided into subscales. The numbers in parentheses indicate the position of each question in the evaluation grid (Appendix 2). For the sake of this presentation, the questions have been reordered following the theoretical order in which they are discussed in the article; the actual order of presentation was: 1 - 1a - 2- 31 - 31a - 32 - 11 - 11a - 12 - 21 - 21a - 22 - 3 - 3a - 4 - 5 - 6 - 6a - 33 - 33a - 35 - 35a - 34 - 37 - 38 - 13 - 13a - 14 - 14a - 15 - 15a - 16 - 16a - 23 - 23a - 24 - 26 - 27 - 28 - 36 - 7 - 7a - 8 - 8a - 9 - 10 - 39 - 29 - 17 - 17a - 18 - 19 - 20.

Th.o.m.a.s. being a semi-structured interview means that the interviewee's replies may sometimes anticipate some questions that would have the subject of a specific question at a later point. Analogously, explanations and examples may or may not be spontaneously offered by the interviewee. Therefore, a certain redundancy exists in the interview as it is presented here; this serves to remind the interviewer to ask for all the information needed, unless it has been spontaneously provided by the interviewee.

Introduction

We are examining the idea of mind that each of us has. This study is being conducted on behalf of the University.

To this purpose we have devised a series of questions aimed at understanding what is generally meant by "mind". These questions cannot evaluate the interviewee's intelligence or personality. There are no correct or incorrect answers to them: each reply simply reflects each person's position in relation to the topic.

The questions are not meant to be inquisitive: when you are asked to give examples based on your personal experience, this is only done to help us understand exactly what you mean. You may refuse to answer any question if you so wish, and we shall end this interview at any moment if you become unwilling to continue.

We ask that you either reply sincerely or not at all: we prefer you to leave a blank space than to give an insincere reply.

Finally, please do not hesitate to ask any explanations you may require about the meaning of the questions. You may take as much time as you need to answer the questions.

If you wish to ask me any question now, I will be pleased to answer it. Otherwise, we can start as soon as you are ready.

Scale A (I-Me)

[1] Do you happen to experience emotions that make you feel good?
What? On what occasions? Can you give an example?

[1a] (If the answer is negative)
Why not?

[2] When you feel good, does that make any difference to you?
What are the differences?
Can you give an example of how you act or think, or of things that happen to you when you feel good?

[3] Do you happen to experience emotions that make you feel bad?
What? On what occasions? Can you give an example?

[3a] (If the answer is negative) Have you ever asked yourself why?

[4] When you feel bad, does that make any difference to you?
What are the differences?
Can you give an example of how you act or think, or of things that happen to you when you feel bad?

[5] When you feel bad, do you feel you understand why?
Can you give an example?
[6] Can you change your mood, when you want to?
How? On what occasions? Can you give me an example?

[6a] (If the answer is negative)
Why can't you?

[7] Do you happen to have wishes, and know what you want?
What? On what occasions? Can you give an example?

[7a] (If the answer is negative)
Do you ever ask yourself why?

[8] Do you try to fulfill your wishes?
How? On what occasions? Can you give an example?

[8a] (If the answer is negative)
Why don't you try?

[9] Do you succeed in getting what you want?
How? On what occasions? Can you give an example?

[10] Can you explain why you succeed/do not succeed?

Scale B (Other-Self)

[11] Do the other persons happen to experience emotions that make them feel good?
What? On what occasions? Can you give an example?

[11a] (If the answer is negative)
Why not, in your opinion?

[12] When the others feel good, does that make any difference to them?
What differences does it make?
Can you give an example of how they act or think, or of things happening to them when they feel good?

[13] And do the other persons happen to experience emotions that make them feel bad?
What? On what occasions? Can you give an example?

[13a] (If the answer is negative)
Why not, in your opinion?

[14] When the others feel bad, does that make any difference to them?
What differences does it make?
Can you give an example of how they act or think, or of things happening to them when they feel bad?

[15] In your opinion, when the others feel bad, do they understand why?
Can you give an example?

[15a] (If the answer is negative)
Why don't they understand, in your opinion?

[16] And, in your opinion, can the others change their mood when they want to?
How? On what occasions? Can you give an example?

[16a] (If the answer is negative)
Why not, in your opinion?

[17] Do the others happen to have desires and know what they want?

What sorts of desires do they have? Can you give an example?

[17a] (If the answer is negative)

Why not, in your opinion?

[18] Do the others try to fulfill their desires?

How? On what occasions? Can you give an example?

[18a] (If the answer is negative)

Why don't they try, in your opinion?

[19] In your opinion, do the others succeed in getting what they want?

How? On what occasions? Can you give an example?

[20] Why do/don't they manage, in your opinion?

Scale C (I-Other)

[21] Do you notice when the others feel good?

When does that happen? Can you give an example?

[21a] (If the answer is negative)

Why don't you notice?

[22] When you notice that another person feels good, does that make any difference to you?
What differences does it make?

Can you give an example, of how you act or think, or of the things that happen to you?

[23] Do you notice when the others feel bad?

When do you notice that? Can you give an example?

[23a] (If the answer is negative)

Why don't you notice?

[24] When you notice that another person feels bad, does that make any difference to you?
What differences does it make?

Can you give an example of how you act or think, or of the things that happen to you?

[25] When the others feel bad, do you understand why?

Can you give an example?

[25a] (If the answer is negative)

Why can't you explain why other people feel bad?

[26] Do you ever want to influence the mood of the others?

How? On what occasions? Can you give an example?

[27] Do you succeed in doing so?

How? On what occasions? Can you give an example?

[28] How do you explain the fact that you manage/do not manage to do so?

[29] Do you think you understand the others' wishes?

What sort of wishes do they have? Can you give an example?

Scale D (Other-Me)

[31] Do the others notice when you feel good?

When do they notice? Can you give an example?

[31a] (If the answer is negative)

Why don't they notice?

[32] When the others notice that you feel good, does that make any difference to them?
What differences does it make? Can you give an example of how they act or think when they notice that you feel good?

[33] Do the others notice when you feel bad?
When do they notice? Can you give an example?

[33a] (If the answer is negative)
Why don't they notice?

[34] When the others notice that you feel bad, does that make any difference to them?
What differences does it make?
Can you give an example of how they act or think when they notice that you feel bad?

[35] When you feel bad, do the others understand why?
Can you give an example?

[35a] (If the answer is negative)
Why don't they understand?

[37] Can the others influence your mood?
How? On what occasions? Can you give an example?

[38] How do you explain that they succeed/do not succeed in doing so?

[39] Do you think that the others understand your desires?
In your opinion, what sort of wishes do they think you have? Can you give an example?

Appendix 2. Interview data coding grid

This appendix contains the grid for the coding and the insertion of the replies. Each question prompts the interviewee to supply a personal opinion regarding a specific aspect of how her mind or the mind of the others works. For example, question [3]: " Do you happen to experience emotions that make you feel bad?" investigates the interviewee' ability to identify her own positive emotions (Scale A: I-Me; subscale: Awareness; dimension: Positive emotion).

The scores for each question are inserted in the corresponding cell, to provide both qualitative and quantitative data for the various domains of theory of mind.

Scale	A (I–Me)			B (Other–Self)		
Subscale	Awareness	Relation	Realization	Awareness	Relation	Realization
Beliefs	×	5	10	×	15 (15a)	20
Desires	7 (7a)	8 (8a)	9	17 (17a)	18 (18a)	19
Positive emotions	1 (1a)	2	6 (6a)	11 (11a)	12	16 (16a)
Negative emotions	3 (3a)	4		13 (13a)	14	
Totals						

Scale	C (I–Other)			D (Other–Me)		
Subscale	Awareness	Relation	Realization	Awareness	Relation	Realization
Beliefs	×	25 (25a)	28	×	35 (35a)	38
Desires	29	26	×	39	×	×
Positive emotions	21 (21a)	22	27	31 (31a)	32	37
Negative emotions	23 (23a)	24		33 (33a)	34	
Totals						

Appendix 3. Rating criteria

This appendix contains the criteria used for scoring the replies.

The interview is recorded (with the interviewee's permission) and transcribed; the replies are rated on the transcript.

Each judge assigns each reply a score ranging from 0 to 4 and inserts it in the relevant cell; each cell thus corresponds to a reply given by the interviewee and represents the specific intersection between two of the dimensions investigated.

The sample replies reported below are taken from actual interviews of the subjects who participated in the study (I = interviewer; H = healthy control; S = schizophrenics).

Score = 0

A score of 0 is attributed:

- when the interviewee remains silent, however encouraged by the interviewer;
- when the reply is incomprehensibly confused, or completely irrelevant to the question, or detached from reality, as in the following example:

(I) And do the other persons experience emotions that make them feel good? Positive emotions... Do the others, like your friends or the members of your family experience positive emotions?

(Schizophrenic) ...No.

(I) Don't the others experience positive emotions?

(S) No

(I) Why, according to you, don't they?

(S) Perhaps, they don't have them, they have no morals, they are immoral, I don't know.

(I) Therefore, since they are immoral, they don't experience them?

(S) These are facts.

(I) And therefore they do not have positive emotions.

(S) No, I don't think they do.

Score = 1

A score of 1 is attributed:

- when the interviewee gains time without in fact providing any meaningful reply;
- when the interviewee says that she does not know how to reply or limits herself to replying yes or no without adding anything else, however encouraged by the interviewer;
- when the reply is confused or inconsistent with regard to the question;
- when an example is provided (spontaneously or after a request by the interviewer) which does not appear consistent with the reply itself, as in the following example:

(I) And when people feel good, does something change in them?

(S) No, something changes in the fact that I am there for them, let's say that they can rely on me.

(I) Can you give an example?

(S) It happened with this teacher.

Score = 2

A score of 2 is assigned to a reply which:

- is confused, albeit relevant to the question;
- is a mere repetition of the question without any further consideration or explanation (e.g., a tautological reply);
- expresses an emotional tone which is inconsistent with the question (e.g. an emotionally positive reply to a question concerning negative emotions);
- is not correctly aligned with the perspective required by the question, e.g. when the question concerns another person's emotional states (allocentric perspective) and the reply only refers to the interviewee himself or herself (egocentric perspective). For example:

(I) When you feel good, do other people notice this?
 (S) To repeat, when I feel good, that is to say, I, my character... I have always tried to have a character, so as not to reveal my moods, because when I had those... those few moments I tried... to stay alone for a moment and then afterwards...
 (I) On the other hand, when you feel good, do they then notice that?
 (S) No, but they usually never see when I don't feel well because, I repeat, when I don't feel well, I tend to isolate myself, to be on my own...
 (I) So what you say is that the others always see you, however, when you feel good, that is only when you feel good, because when you don't feel good, you disappear...
 (S) But, to repeat, I'm not such a melodramatic person, yes, I have those moments, I get mad and I say S. (*says his own name*) you've got to react, there exists a problem, let's try to solve it...
 (I) Therefore, the example is, precisely, your daily life, let's say...
 (S) Yes
 (I) OK.

Score = 3

A score of 3 is assigned to a reply which:

- is not articulated;
- is articulated and coherent, but provided with difficulty or only after several attempts on the part of the interviewer;
- is consistent with the question but has no concrete, meaningful example;
- provides an example which is approximate, generic, meaningless, or only refers to behaviors instead of mental states or events;
- is coherent and consistent, but generic, stereotyped or only slightly contextualized. For example:

(I) When you feel good, does something change in you, in your way of acting or thinking?
 (H) Yes, I act more willingly, more calmly.
 (I) What do you mean, more willingly?
 (H) In the sense that I do something, both concerning the field of work or the... normal field.
 (I) OK. Fine. Do you remember an occasion on which you felt good and, as a result, you felt more inclined to do something, more willing?
 (H) Yes, more willing. A particular occasion... no, not at this moment...
 (I) For example, that time when you dated this girl... what changed in you?
 (H) Well, the change was that I felt rather... how can I say... rather... agitated, then I felt happy, I took... more willingly, wow, in my way of acting, doing...

Score = 4

A score of 4 is attributed to a reply which:

- is coherent, detailed and organized, with significant, coherent and contextualized examples;
- refers in different ways to the interviewee's own mental states and events and to those of the others, thus providing not a generic or prototypical reply, but a contextualized one which bears a relation to the interviewee's personal experience. For example:

(I) Do you experience emotions that make you feel good?
 (H) Well, certainly, emotions are the most important things you can experience in your life, therefore there are emotions that can be linked to feelings, to what you see, therefore if you go to a beautiful place that yields emotions in you... for example, last winter I went to Brazil, I spent New Year's Eve in Brazil and I experienced wonderful emotions concerning how the people are, how I fitted in, like an emotion of feeling love for someone or finding, let's say of falling in love with another person, that is to say there are many moments in which one feels emotions.

To obtain a score of 4, it is not necessary for the interviewee to provide an example based on her personal experience: it is sufficient that the reply is contextualized in a well detailed manner, that there are differentiations; thus, an invented example may suffice if it is meaningful and well contextualized.

Figures

Figure 1. Schizophrenics vs. controls: mean total scores at Th.o.m.a.s. and mean scores at the individual scales (range: 0–4) with standard error bars.

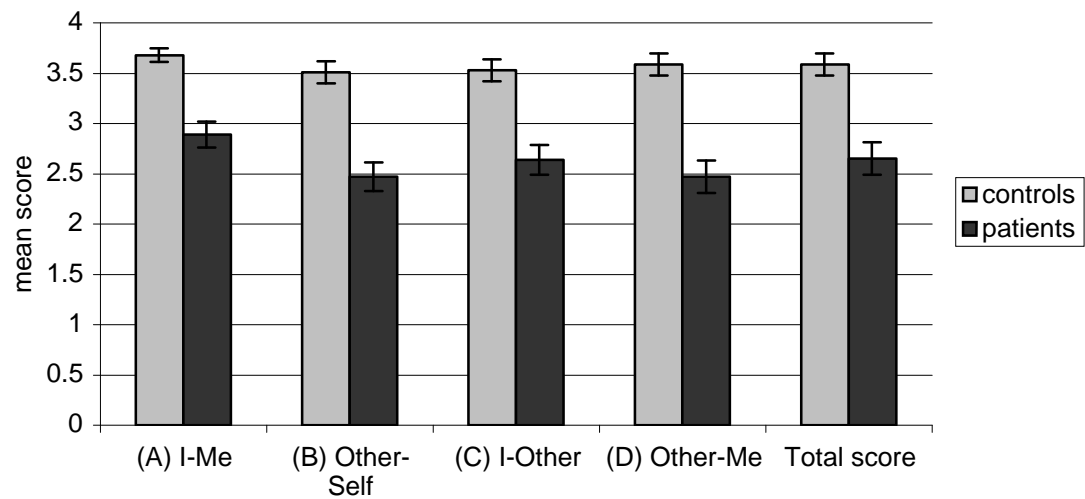


Figure 2. Schizophrenics vs. controls: mean total scores at Th.o.m.a.s. and at the individual subscales (range: 0–4) with standard error bars.

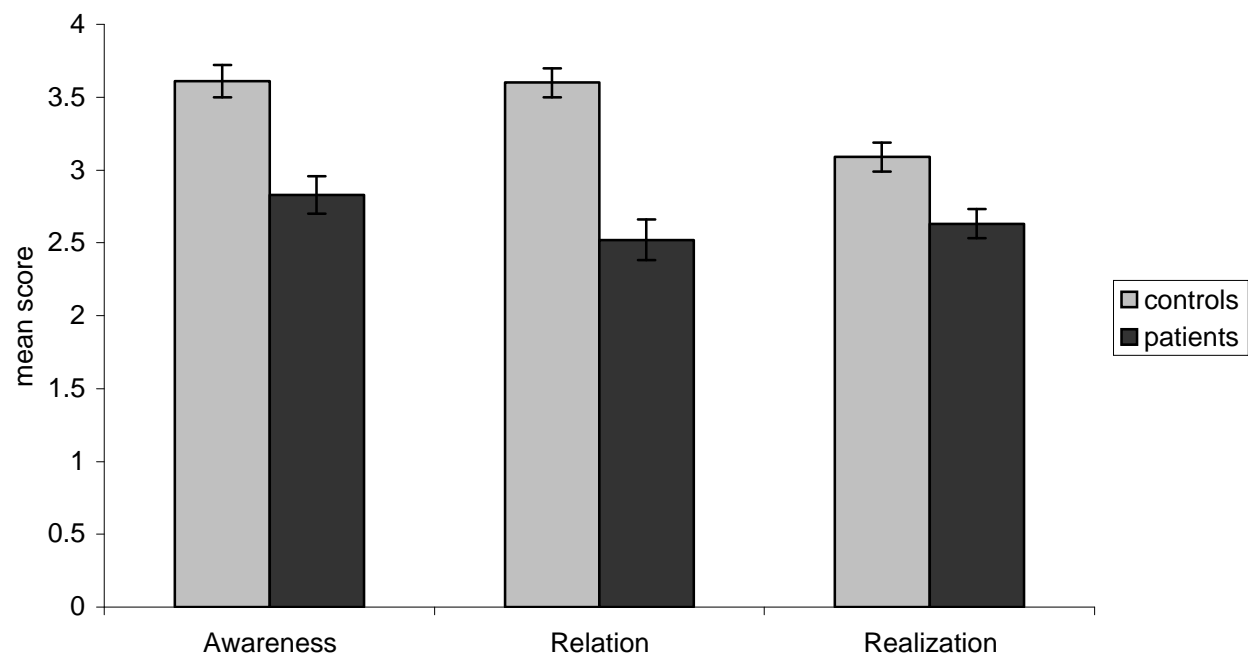
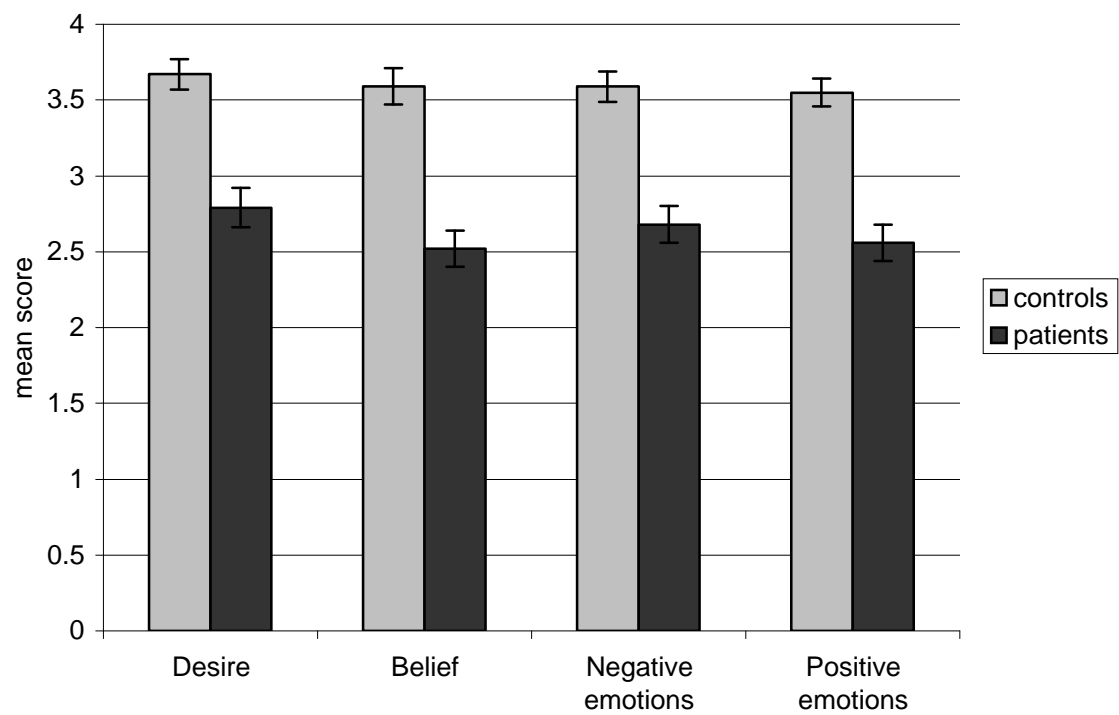


Figure 3. Schizophrenics vs. controls: mean total scores at Th.o.m.a.s. and at the four dimensions (range: 0–4) with standard error bars.



Tables

Table 1. Schizophrenic patients: Correlations between Th.o.m.a.s. and IQ, PANSS, ToM tasks (Correlation Coefficient)

PANSS:	Th.o.m.a.s. scales									
	A I–Me 1st person egocentric		B Other–Self 3rd person allocentric		C Me–Other 3rd person allocentric		D Other–Me 3rd person allocentric		Totals 4 scales	
	Corr.	p	Corr.	p	Corr.	p	Corr.	p	Corr	p
Negative symptoms	.86	<.0001	-.84	<.001	-.85	<.001	-.65.	.001	-.87	<.001
Positive symptoms	-.47	.02	-.13	n.s.	-.48	.02	-.28	n.s.	-.45	.047
General symptoms	-.50	.016	-.43	.04	-.63	.002	-.45	n.s	-.62	.003
QI	.26	n.s.	.48	.02	.59	.005	.69	.0004	.57	.007
Years of education	.22	n.s.	.26	n.s.	.39	n.s.	.54	.01	.40	n.s.
ToM tasks (Total)	.52	.013	.45	.033	.65	.0013	.41	n.s.	.54	.013